Production of coir pith compost without adding urea

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One of the important by-products coming out from the coconut based coir production units is the light-weight, non-fibrous, spongy and granular coir-pith biomass remaining after the extraction of long fibres from the fresh or retted mature coconut husks. The extracted fibres are then used for making yarns, mats, matting, mattresses, geo-textiles etc. The coir-pith acts as binding agent in the husk that keeps the fibres tightly packed. In order to release the fibre from the binding coir-pith, retting of the husks is usually carried out. Retting involves immersing large bundles of coconut husk in water bodies such as ponds, lakes or slow moving rivers for 6 to 12 months. Because of microbiological activity, the fibres in the husk are loosened from the cementing coir pith within the period. Long clean uncoloured coir fibres are then extracted from the retted husks using a mallet or mechanical extractor machines. Alternatively, coir fibre can be extracted from fresh unretted husk too using mechanical fibre extractor. During the extraction of fibre, large volume of coir dust or coir-pith is generated and gets accumulated posing environmental issues. This coir-pith residue can be used in agri-horti applications (Prabhu and Thomas, 2002), poultry farming (Maheswarappa et al., 2000), and for scientific purposes such as maintaining grubs of rhinoceros beetle for culturing Oryctes baculovirus (now termed Nudivirus) (Gopal and Gupta, 2001) among other things.

The physical properties of high porosity and water holding capacity up to 500 to 600% (Evans et al, 1996) of coir-pith makes it a unique input as soil amendment. In addition it contains high concentration of potash which makes it more useful. However, high polyphenolic content makes raw coir-pith toxic to roots of many crops. Every year about 0.5 to 1 million tonnes of coir-pith waste is produced in India that can be recycled as input in agriculture after composting. Therefore, composting is

Coconut husk made of fibres and coir-pith

Retting husk for coir production

Separating coir fibre from pith using mechanical extractor

an ideal option for its beneficial utilization in agriculture as this can help in reducing the concentration of toxic phenolics and make the plant nutrients easily available.

Composting coir-pith with urea addition

Composting coir-pith is a challenge because it possesses high C: N ratio of anywhere between 52 to 112: 1 (Savithri and Khan, 1994), high lignin content varying from 30 to 54% as well as high phenolic concentration making it difficult to be decomposed by microorganisms. In order to make it amenable to microbial decomposition, the C:N ratio is reduced by addition of urea followed by addition of ligno-cellulose degrading mushroom fungi such as Pleurotus sajor-caju (Nagarajan et al., 1988). A Pleurotus sajor caju based bioinoculant 'PithPlus' was developed by Central Coir Research Institute, Alleppey for composting of coir-pith with addition of urea (Ravindranath, 2008). The resulting compost was termed C-POM: coir-pith organic manure. The coir-pith compost produced by this technology is a good source of manure that improves the physical properties, adds valuable plant nutrients to soil besides being used as plant growth medium for horticultural and field crops. However, this technology depends on regular supply of the mushroom fungal culture for composting the coir pith which at times becomes the limiting factor from farmer's point of view.

Raw coir pith

Coir pith+poultry manure + lime + rock Composted coir pith

Phosphate heaps

Co-composting of coir-pith without urea addition

Co-composting is a concept in which organic materials with high nitrogen content and low C:N ratio such as animal manures are mixed with organic materials having low nitrogen and high C:N ratio such as coir pith. The mixing of the high C:N with low C:N material helps in improved microbial decomposition of the substrates. Co-composting of coir-pith using cow manure, rice-bran, molasses and coconut juice was attempted for coir-pith composting in Thailand (Tripetchkul et al., 2012). However, this involves several components that may not be easily available at a given time.

A more simple, farmer friendly technology was developed at ICAR-Central Plantation Crops Research Institute, Kasaragod for composting coir-pith that does not involve addition of urea as nitrogen source for reducing the C:N ratio or mushroom fungi (Pleurotus spp.) for substrate decomposition. This is a low-cost, simple and rapid co-composting technology based on local resources such as poultry manure, lime and rock phosphate (Thomas et al., 2013) that can be adopted easily by farmers and cottage-industry level entrepreneurs.

Co-composting of coir-pith using poultry manure

For production of coir pith compost on a large scale, a suitable place is selected that has good shade and is protected from direct rain falling on the composting site. Alternatively, greenhouse nets draped on wooden poles can be used to create a shaded area. The technology requires five main inputs i.e., coir pith, poultry manure, lime (calcium oxide), rock phosphate (available as Rajphos in local fertilizer stores) and water. Around 900 kg of coir-pith is mixed with 100 kg of good quality poultry manure along with 5 kg of lime and 5 kg of rock phosphate. After proper mixing, it is spread evenly in an area of 4 x 2 x 1 m (l x b x h) dimensions. Water is sprinkled regularly over this mixture. The watering helps

Table 1. Population of different microbial communities in coir-pith compost produced using poultry manure

Microbial community	Bacteria	Fungi	Actinomycetes	Phosphate solubilizers	Nitrogen fixers	Fluorescent pseudomonads
Population count (cfu/g compost; log10 transformed)	7.8	5.9	7.4	5.6	4.6	4.4

the whole coir pith heap to remain sufficiently moist. Over wetting and drying should be avoided. The heap is covered with gunny bags or green house net or dry grass to prevent moisture loss. The whole heap is turned once in 15 days. Turning the heap enhances the speed of decomposition indicated by colour change of reddish brown raw coir pith to dark brown colour. After 45-60 days, the coir pith will become dark brown to black colour indicating the completion of composting process. The final product can be shade dried and packed for sale or farm use.

The urea-free coir-pith compost produced using this co-composting technology is available at ICAR-CPCRI under the brand name 'Kalpa Soil Care'.

Properties of urea-free coir pith compost

The coir-pith compost produced by urea-free technology is highly porous, dark coloured, odour free product, with pH in the range of 6.1 to 6.4 and having up to 500% water holding capacity. The final product possesses C:N ratio of 21 to 22 and organic carbon content of 28-30%. The total N, P and K content ranges between 1.3 to 1.4, 0.9 to 1.2 and 1.3 to 1.6 %, respectively. It is also a good source of plant micronutrients such as Fe, Cu, Zn and Mn. Microbiologically, the urea-free coir pith compost is rich in plant-beneficial microbes such as free-living nitrogen-fixing and phosphate solubilizing bacteria (Table 1). It also has significantly high populations of actinomycetes which are known to produce antibiotics and help in suppression of soil pathogens.

Advantages of urea-free coir-pith compost

This easy to make urea-free coir-pith compost produced using poultry manure through co-composting technology can be an ideal input for organic cultivation of field and horticultural crops. It can be applied to coconut, arecanut, cocoa, rubber and oilpalm @ 20-25 kg/tree/year; about 2-4 tonnes/ha for vegetables and ornamental crops; and 2-2.5 tonnes for paddy. The addition of coir pith compost improves the physical properties and water holding capacity of soil. It increases the organic matter and carbon content of poor humid tropical soils. It also helps in better root formation and enhances crop growth. It also serves as an ideal medium for raising pot-tray seedlings.

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